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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/843,924	04/30/2001	Kazunori Sakurai	109182	9915
25944	7590	04/27/2004	EXAMINER	
OLIFF & BERRIDGE, PLC			OWENS, BETH E	
P.O. BOX 19928			ART UNIT	PAPER NUMBER
ALEXANDRIA, VA 22320			2824	

DATE MAILED: 04/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/843,924

Applicant(s)

SAKURAI ET AL.

Examiner

Beth E. Owens

Art Unit

2824

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-27, 31 and 32 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-27, 31 and 32 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 April 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |  |
|--|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)            |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>12.17.03 / 11.20.02</u> | 6) <input type="checkbox"/> Other: ____  |

## DETAILED ACTION

### *Specification*

1. The disclosure is objected to because of the following informalities:

Paragraph [0013]: please replace “end” with --boundaries-- or --periphery-- as the pad by Applicant’s definition may be circular or rectangular (paragraph [0069]) and there and no “ends” with a circle. As the term “periphery” is used in the claims it is suggested that “periphery” would be the better choice.

Paragraph [0015]: please replace “the inner side of the periphery of the pad and at the outer side of the center, in which the insulating film is thinner, of the pad.” with --inside the periphery of the pad but towards the center of the pad, where the insulating film is thinner.-- This is in keeping consistent with the claims and paragraph [0013] in which the periphery or outer boundaries of the pads are covered with a thicker portion of the insulating layer.

Paragraph [0066]: please replace “Fig. 3(A) to Fig. 2(C)” with --Fig. 3(A) to Fig. 3(C)-- and “Fig. 14(B)” to --Fig. 14(C)--.

Paragraph [0069]: please replace “Copper” with --copper--.

Paragraph [0070]: please replace “SiO<sub>2</sub>” with --SiO<sub>2</sub>--.

Paragraph [0087]: please insert --(not shown)-- after “layer 32”.

Appropriate correction is required.

***Claim Objections***

2. The following Claims are objected to because of the following informalities:

Claim 1, line 7: please replace "at" with --in--.

Claim 6, line 2: please replace "a" with --the--.

Claim 14, line 2: please replace "a" with --the--.

Claim 17, line 3: please replace "a" with --the--.

Claim 31, line 1: please delete the comma and the colon.

Claim 32, line 1: please delete the comma and the colon.

***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 1 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim does not point out if the resist layer is formed on top of or underneath the insulating film. This rejection may be overcome by inserting --covered with an insulating film-- after "pad" in line 3 and replacing "an insulating" with --the insulating-- in line 4.

The claim does not point out the location of the formation of the metal layer constituting a bump after forming the opening. This rejection may be overcome by inserting --in the opening-- after “bump” in line 6.

5. Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim language in line 2 includes the term “protrude”. Holes are not formed as to “protrude from” the periphery of the pad, but rather --extend beyond-- the periphery of the pad. This rejection may be overcome by replacing “protrude from” with --extend beyond--.

6. Claim 3 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim language in line 2 is confusing as the pad may be either circular or rectangular according to the Specification. Replacing “at an end of the pad than at a center of the pad” with --at the periphery of the pad than at the center-- keeps the language consistent throughout the claims and removes the confusion about “ends” of circular-shaped pads or which set of edges in rectangular-shaped pads.

7. Claim 4 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim language in line 2 is confusing: “at an interior periphery of the pad and at a larger portion of the pad, where the insulating film is thinner.” There are no interior and exterior boundaries to a pad and “larger portion of the pad where the insulating film is thinner” does not match the specification in which the insulating film is thinner towards the center and thicker towards the periphery, or boundary of the pad. This rejection may be overcome by replacing the above language with:  
--inside the periphery of the pad towards the center of the pad, where the insulating film is thinner.--

8. Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The limitation in lines 2 and 3 recites: “to define a region for forming the first metal layer and an exposed portion of the pad”. The language is confusing as the region does not do the forming of the metal layer nor does one form an exposed portion of a pad. This rejection may be overcome by rewriting the limitation to recite: “to define a region upon which to form the first metal layer and to leave an exposed portion of the pad”.

9. Claim 15 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 15 contains the limitation: “the metal layer being formed so as to be substantially flush with the resist layer”. This does not distinctly point out the relationship between the two layers as the metal layer may be formed out of the opening and across the surface of the resist layer, the upper surface of the resist layer therefore being flush with the lower surface of the metal layer. This rejection may be overcome by rewriting the limitation to recite: --“the upper surface of the metal layer being formed so as to be substantially flush with the upper surface of the resist layer”--.

10. Claims 16 and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Lines 1 and 2 of claim 16 and 3 and 4 of claim 17 contain the limitation: “the first metal layer being formed so as to be lower than the resist layer”. This does not distinctly point out the relationship between the levels of the upper surfaces of the two layers. This rejection may be overcome by rewriting the limitation to recite: --the upper surface of the first metal layer being formed so as to be lower than the upper surface of the resist layer--.

***Claim Rejections - 35 USC § 102***

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

12. Claims 1, 2, 5, 8, 25, 27, 31 and 32 are rejected under 35 U.S.C. 102(e) as being anticipated by Farrar.

In regards to Claim 1:

Paragraphs [0040]-[0042]:

[0040] *After the metal contact pads 150 have been formed, a second insulating layer 160 is added overtop of the device 100, as shown in FIG. 4(J). This insulating layer 160 can be formed of conventional insulating material, such as polyimide, and is preferably approximately 1.5 microns thick. Although polyimide is preferred for this layer, any insulator known to those skilled in the art may be used (e.g., silicon dioxide, silicon nitride, fluorinated silicon dioxide).*

[0041] *FIG. 4(K) shows the next step where a third photoresist layer 170 is deposited. The photoresist layer 170 is preferably approximately 2.5 microns thick. The photoresist layer 170 is exposed and patterned, as shown in FIG. 4(L), to define through holes 180 in the areas above the metal contact pads 150. Then, the insulator 160 is etched through the holes 180 so that portions of the metal contact pads 150 are exposed, as shown in FIG. 4(M).*

[0042] *Next, as shown in FIG. 4(N), the photoresist layer 170 is removed from device 100. In one embodiment, solder is selectively deposited on the exposed portions of metal contact pads 150, forming solder contacts 200 in the through*

*holes 180, by immersing the device 100 in molten solder. The molten solder will selectively attach to the exposed metal upon contact, forming solder contacts 200 shown in FIG. 4(O).*

In regards to Claim 2:

Paragraph [0041] discloses that the through hole is formed directly above the metal contact pads, as also illustrated in Fig. 4(M).

[0041] FIG. 4(K) shows the next step where a third photoresist layer 170 is deposited. The photoresist layer 170 is preferably approximately 2.5 microns thick. *The photoresist layer 170 is exposed and patterned, as shown in FIG. 4(L), to define through holes 180 in the areas above the metal contact pads 150. Then, the insulator 160 is etched through the holes 180 so that portions of the metal contact pads 150 are exposed, as shown in FIG. 4(M).*

In regards to Claims 5 and 8:

[0048] A still further embodiment is described with reference to FIGS. 4(A)-4(M) and 6(A)-6(C). In this embodiment, processing proceeds to the etching of through holes 180 to metal contact pads 150 as shown in FIG. 4(M).

*Instead of removing the resist at this stage, a layer of lead 220 is applied to the exposed portions of metal contact pads 150 through electrolysis. A layer of tin 230 is then formed on the layer of lead 225. The lead layer 225 is preferably approximately 0.91 microns deep. The tin layer 230 is preferably approximately 1.42 microns deep. The lead layer 225 and the tin layer 230 collectively form the solder contacts 200 as shown in FIG. 6(A). Other metallurgies may be substituted for the lead/tin combination, and the deposition may include more than two layers.*

[0049] *Photoresist layer 170 is then removed, exposing solder contacts 200 above the surface of insulating layer 160 as shown in FIG. 6(B).*

In regards to Claims 25, 27, 31 and 32:

Paragraphs [0052]-[0064] describe the bump incorporated in semiconductor chips, semiconductor devices, circuit boards and electronic devices.

*Claim Rejections - 35 USC § 103*

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. Claims 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Farrar.

In regards to Claims 18-20:

In his disclosure, Farrar teaches the use of two or more metal layers, in his example specifically lead and tin, as the first and second metal layers, respectively. He is silent, however, in regards to the first and second metal layers being a nickel-containing material and a gold-containing material, respectively, or that the second metal layer includes a solder. However, he teaches in paragraph [0048] that other combinations of metallurgies may be substituted for the lead/tin combination:

[0048] A still further embodiment is described with reference to FIGS. 4(A)-4(M) and 6(A)-6(C). In this embodiment, processing proceeds to the etching of through holes 180 to metal contact pads 150 as shown in FIG. 4(M).

Instead of removing the resist at this stage, a layer of lead 220 is applied to the exposed portions of metal contact pads 150 through electrolysis. A layer of tin 230 is then formed on the layer of lead 225. The lead layer 225 is preferably approximately 0.91 microns deep. The tin layer 230 is preferably approximately 1.42 microns deep. The lead layer 225 and the tin layer 230 collectively form the solder contacts 200 as shown in FIG. 6(A). *Other metallurgies may be substituted for the lead/tin combination, and the deposition may include more than two layers.*

Examiner takes Official Notice that the use of nickel, or nickel-containing material, and gold, or gold-containing material, as well as solders would have been obvious to one ordinarily skilled in the art at the time the invention was made for the purpose of forming bumps to metal contact pads.

### ***Conclusion***

15. Claims 3, 4, 6, 7, 9-17, 21-24 and 26 would be allowable if rewritten to overcome all objections and the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Beth E. Owens, Ph.D. whose telephone number is 571.272.1882.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms, can be reached on 571.272.1869. The fax

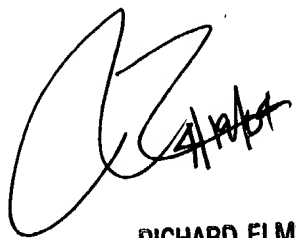
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phone number for the organization where this application or proceeding is assigned is  
703.872.9306 for official communications.

Any inquiry of a general nature or relating to the status of this application or  
proceeding should be directed to the receptionist whose telephone number is  
571.272.2800.

BEO 04.14.04

A handwritten signature in black ink, appearing to read 'R. Elms', is written over a circular stamp.

**RICHARD ELMS**  
**SUPERVISORY PATENT EXAMINER**  
**TECHNOLOGY CENTER 2800**